

Table C.9-1. Initial amount of residual contaminants in facilities following disposition.

| | Sr-90 (Ci) | Tc-99 (Ci) | I-129 (Ci) | Cs-137 (Ci) | Pu-238 (Ci) | Pu-239 (Ci) | Pu-240 (Ci) | Am-241 (Ci) | Np-237 (Ci) | Cd (kg) | F (kg) | Hg (kg) | NO ₃ (kg) |
|--|---------------------|---------------------|-----------------|---------------------|----------------------|----------------------|----------------------|---------------------|-----------------------|---------------------|---------------------|---------------------|-------------------------|
| Tank Farm ^a | 9.3×10 ⁴ | 23 | 0.12 | 9.3×10 ⁴ | 790 | 130 | 24 | 120 | 6.7 | 79 | 0.33 | 130 | 35 |
| Tank Farm (No Action) ^b | 2.4×10 ⁵ | 60 | 0.34 | 2.4×10 ⁵ | 2.1×10 ³ | 340 | 65 | 330 | 18 | 2.8×10 ³ | 8.8×10 ³ | 1.1×10 ³ | 1.3×10 ⁶ |
| Bin sets ^c | 4.8×10 ⁴ | 18 | NA ^f | 4.5×10 ⁴ | 430 | 11 | 7.3 | 43 | 0.17 | 230 | 4.2×10 ³ | 18 | 1.3×10 ³ |
| Bin sets (No Action) ^c | 9.6×10 ⁶ | 3.6×10 ³ | NA ^f | 8.9×10 ⁶ | 8.7×10 ⁴ | 2.1×10 ³ | 1.5×10 ³ | 8.7×10 ³ | 34 | 4.7×10 ⁴ | 8.5×10 ⁵ | 3.7×10 ³ | 2.5×10 ⁵ |
| New Waste Calcining Facility ^d | 740 | 0.35 | NA ^f | 850 | 20 | 0.13 | 0.08 | 0.7 | 7.0×10 ⁻³ | 0 | 2.1×10 ⁵ | 4.5×10 ³ | 2.3×10 ⁴ |
| Process Equipment Waste Evaporator ^d | 740 | 0.35 | NA ^f | 8.50 | 20 | 0.13 | 0.08 | 0.7 | 7.0×10 ⁻³ | 0 | 2.1×10 ⁵ | 4.5×10 ³ | 2.3×10 ⁴ |
| Class A grout in low-activity waste disposal facility ^e | 0.58 | 1.9×10 ³ | 1.7 | 7.0×10 ³ | 1.3×10 ⁻⁵ | 2.5×10 ⁻⁷ | 2.0×10 ⁻⁷ | 130 | 5.8×10 ⁻¹⁰ | 1.4×10 ⁶ | 1.9×10 ⁹ | 2.5×10 ⁷ | 0 |
| Class C grout in low-activity waste disposal facility ^e | 1.1×10 ⁷ | 3.7×10 ³ | 8.6 | 9.6×10 ⁶ | 1.4×10 ⁻⁵ | 2.6×10 ⁻⁷ | 2.2×10 ⁻⁷ | 130 | 6.8×10 ⁻¹⁰ | 1.4×10 ⁶ | 3.6×10 ⁹ | 4.5×10 ⁷ | 0 |
| Class A grout in Tank Farm ^g | 9.3×10 ⁴ | 970 | 0.97 | 9.6×10 ⁴ | 790 | 130 | 24 | 190 | 6.7 | 7.0×10 ⁵ | 9.5×10 ⁸ | 1.3×10 ⁷ | 35 |
| Class C grout in Tank Farm ^h | 5.6×10 ⁶ | 1.9×10 ³ | 4.4 | 4.9×10 ⁶ | 790 | 130 | 24 | 190 | 6.7 | 7.0×10 ⁵ | 1.8×10 ⁹ | 2.3×10 ⁷ | 35 |
| Class A grout in bin sets ^g | 4.6×10 ⁴ | 970 | 0.85 | 4.8×10 ⁴ | 430 | 11 | 7.3 | 110 | 0.17 | 7.0×10 ⁵ | 9.5×10 ⁸ | 1.3×10 ⁷ | 1.3×10 ³ |
| Class C grout in bin sets ^h | 5.6×10 ⁶ | 1.9×10 ³ | 4.3 | 4.8×10 ⁶ | 430 | 11 | 7.3 | 110 | 0.17 | 7.0×10 ⁵ | 1.8×10 ⁹ | 2.3×10 ⁷ | 1.3×10 ³ |

a. Source: Beck (1999a).

b. Source: Beck (1999b,c).

c. Source: Staiger (1999).

d. Source: Demmer and Archibald (1995).

e. Source: Russell et al. (1998).

f. NA = means that there is no information to indicate the presence of the contaminant in the listed facility.

g. Value represents one-half of the "Class A grout in low-activity waste disposal facility" entry plus the facility residual value (i.e., "Tank Farm" and "bin set" entries).

h. Value represents one-half of the "Class C grout in low-activity waste disposal facility" entry plus the facility residual value (i.e., "Tank Farm" and "bin set" entries).

Table C.9-5. Radionuclide inventory used in the derivation of external dose rates from dispositioned facilities.

| Radionuclide | HLW Tanks (Ci/m ³) | | | | Bin Sets (Ci/m ³) ^c | | | | Low Activity Waste Disposal Facility (Ci/m ³) ^d | | | | New Waste Calcining Facility (Ci/m ³) ^e | Process Equipment Waste Evaporator (Ci/m ³) ^e |
|--------------|--------------------------------|-----------------------|--|--|--|----------------------|-----------------------------|-----------------------------|--|----------------------|----------------------|----------------------|--|--|
| | No Action ^a | Residual ^b | Residual plus Class A Grout ^b | Residual plus Class C Grout ^b | No Action | Residual | Residual plus Class A Grout | Residual plus Class C Grout | Class A Grout | Class C Grout | Class A Grout | Class C Grout | | |
| | | | | | | | | | | | | | | |
| Am-241 | 1.7×10 ⁻⁵ | 6.5×10 ⁻³ | 0.012 | 0.012 | 2.6 | 0.013 | 0.018 | 0.019 | 0.70 | 0.70 | 0.095 | 0.095 | | |
| Ba-137m | 42 | 6.2 | 6.4 | 400 | 2.0×10 ³ | 10 | 10 | 410 | - | - | 110 | 110 | | |
| Co-60 | - | 8.3×10 ⁻⁴ | 8.3×10 ⁻⁴ | 8.3×10 ⁻⁴ | - | - | - | - | - | - | - | - | | |
| Cs-137 | 44 | 6.5 | 6.8 | 430 | 2.1×10 ³ | 11 | 11 | 430 | 850 | 850 | 120 | 120 | | |
| Eu-154 | - | 7.7×10 ⁻³ | 7.7×10 ⁻³ | 7.7×10 ⁻³ | - | - | - | - | - | - | - | - | | |
| I-129 | 6.6×10 ⁻⁵ | 6.5×10 ⁻⁶ | 7.9×10 ⁻⁵ | 3.9×10 ⁻⁴ | - | - | 7.3×10 ⁻⁵ | 7.7×10 ⁻³ | - | - | - | - | | |
| Np-237 | 3.4×10 ⁻³ | 3.7×10 ⁻⁴ | 3.7×10 ⁻⁴ | 3.7×10 ⁻⁴ | 3.0×10 ⁻³ | 1.5×10 ⁻⁵ | 1.5×10 ⁻⁵ | 1.5×10 ⁻⁵ | 7.0×10 ⁻³ | 7.0×10 ⁻³ | 9.6×10 ⁻⁴ | 9.6×10 ⁻⁴ | | |
| Pa-233 | - | 3.7×10 ⁻⁴ | 3.7×10 ⁻⁴ | 3.7×10 ⁻⁴ | 2.6×10 ⁻³ | 1.3×10 ⁻⁵ | 1.3×10 ⁻⁵ | 1.3×10 ⁻⁵ | - | - | - | - | | |
| Pu-238 | 0.4 | 0.044 | 0.044 | 0.044 | 26 | 0.13 | 0.13 | 0.13 | 20 | 20 | 2.8 | 2.8 | | |
| Pu-239 | 0.064 | 7.1×10 ⁻³ | 7.1×10 ⁻³ | 7.1×10 ⁻³ | 0.49 | 2.4×10 ⁻³ | 2.4×10 ⁻³ | 2.4×10 ⁻³ | 0.31 | 0.31 | 0.042 | 0.042 | | |
| Pu-240 | 0.012 | 1.4×10 ⁻³ | 1.4×10 ⁻³ | 1.4×10 ⁻³ | 0.41 | 2.0×10 ⁻³ | 2.0×10 ⁻³ | 2.0×10 ⁻³ | 0.08 | 0.08 | 0.011 | 0.011 | | |
| Pu-241 | - | 0.018 | 0.018 | 0.018 | 9.8 | 0.049 | 0.049 | 0.049 | - | - | - | - | | |
| Ra-225 | - | 5.9×10 ⁻¹¹ | 5.9×10 ⁻¹¹ | 5.9×10 ⁻¹¹ | - | - | - | - | - | - | - | - | | |
| Ra-226 | - | 5.9×10 ⁻⁹ | 5.9×10 ⁻⁹ | 5.9×10 ⁻⁹ | - | - | - | - | - | - | - | - | | |
| Sm-151 | - | 0.065 | 0.065 | 0.065 | - | - | - | - | - | - | - | - | | |
| Sr-90 | 45 | 5.8 | 5.8 | 470 | 2.4×10 ³ | 12 | 1.2 | 480 | 740 | 740 | 100 | 100 | | |
| Tc-99 | 0.012 | 1.2×10 ⁻³ | 0.079 | 0.16 | 0.79 | 3.9×10 ⁻³ | 0.082 | 0.17 | 0.35 | 0.35 | 0.048 | 0.048 | | |
| Th-229 | - | 5.9×10 ⁻¹¹ | 5.9×10 ⁻¹¹ | 5.9×10 ⁻¹¹ | - | - | - | - | - | - | - | - | | |
| Th-230 | - | 3.4×10 ⁻⁷ | 3.4×10 ⁻⁷ | 3.4×10 ⁻⁷ | - | - | - | - | - | - | - | - | | |
| U-233 | - | 3.1×10 ⁻⁸ | 3.1×10 ⁻⁸ | 3.1×10 ⁻⁸ | - | - | - | - | - | - | - | - | | |
| U-234 | - | 1.1×10 ⁻⁴ | 1.1×10 ⁻⁴ | 1.1×10 ⁻⁴ | - | - | - | - | - | - | - | - | | |
| Y-90 | 45 | 5.8 | 5.8 | 470 | 2.4×10 ³ | 12 | 12 | 480 | 740 | 740 | 100 | 100 | | |

a. Source: Beck (1999b,c). Patterned after Tank No. WM-188, which has the highest estimated inventory.

b. Source: Beck (1999a). Patterned after Tank No. WM-185, which is estimated to have highest residual inventory (i.e., after cleaning).

c. Source: Staiger (1999). All bin set cases patterned after Bin Set No. 5.

d. Source: Russell, et al. (1998).

e. Source: Demmer and Archibald (1995).

Table C.9-6. Final results of radionuclide screening for the groundwater release pathway.

| Radionuclide | Half-life | Maximum estimated release following facilities disposition (Ci) | Scenario under which maximum release occurs | Previously assessed release (Ci) ^a | Ratio ^b | Screening outcome |
|---------------------|-------------------------|--|---|--|-----------------------|--------------------------------------|
| Am-241 | 432 years | 1.4×10^{-9} | PEW Evaporator | 111 | 1.3×10^{-11} | Not further assessed |
| Cs-137 | 30 year | 3.9×10^3 | Class C grout in landfill | 3×10^4 | 0.13 | Not further assessed |
| I-129 | 1.6×10^7 years | 8.7 | Class C grout in landfill | 1.5 | 5.8 | Perform quantitative risk assessment |
| Np-237 | 2.1×10^6 years | 5.6×10^{-6} | PEW Evaporator | 1.4 | 4.0×10^{-6} | Not further assessed |
| Sr-90 | 28.6 years | 1.8×10^4 | Class C grout in landfill | 1.9×10^4 | 0.95 | Not further assessed |
| Tc-99 | 2.1×10^5 years | 1.6 | Class C grout in landfill | 2.7 | 0.5 | Perform quantitative risk assessment |
| Pu-238 | 88 years | $<1 \times 10^{-10}$ | PEW Evaporator | 1.2×10^{3c} | 8.3×10^{-14} | Not further assessed |
| Pu-239 | 2.4×10^4 years | 3.3×10^{-7} | PEW Evaporator | 1.2×10^{3c} | 2.8×10^{-10} | Not further assessed |
| Pu-240 | 6,570 years | 6.0×10^{-7} | PEW Evaporator | 1.2×10^{3c} | 5.0×10^{-10} | Not further assessed |
| U-233 | 1.6×10^5 years | 2.7×10^{-7} | PEW Evaporator | 2.0 ^d | 1.4×10^{-7} | Not further assessed |
| U-234 | 2.5×10^5 years | 1.5×10^{-9} | PEW Evaporator | 2.0 ^d | 7.5×10^{-10} | Not further assessed |
| Ac-225 ^e | 10 days | 6.6×10^{-8} | PEW Evaporator | | NA | Not further assessed |
| Pa-233 ^e | 27 days | 5.6×10^{-6} | PEW Evaporator | | NA | Not further assessed |
| Ra-225 ^e | 14.8 days | 6.6×10^{-8} | PEW Evaporator | | NA | Not further assessed |
| Ra-226 ^e | 1,600 years | $<1 \times 10^{-10}$ | PEW Evaporator | | NA | Not further assessed |
| Th-229 ^e | 7,340 years | 6.6×10^{-8} | PEW Evaporator | | NA | Not further assessed |
| Y-90 ^e | 64 hours | 1.7×10^4 | Class C grout in landfill | | NA | Not further assessed |

a. Source: Rodriguez et al. (1997).

b. The “ratio” column presents the quotient of the “maximum estimated release following facility disposition” column and the “previously assessed release” column.

c. Value is for total plutonium.

d. Value is for total uranium.

e. These radionuclides are included because they are decay products of other listed species.

NA = Not Applicable.

Table C.9-7. Final results of nonradiological contaminant screening for the groundwater release pathway.

| Contaminants | Percent of total screening product | | Maximum estimated release following facilities disposition (g) | Facility from which maximum release occurs ^a | Previously assessed release (g) | Screening outcome |
|---------------------|------------------------------------|----------|--|---|---------------------------------|--------------------------------------|
| | Tank Farm | Bin sets | | | | |
| Mercury | 94.47 | 39.49 | 43 | PEW Evaporator | $1.0 \times 10^{6(b)}$ | Not further assessed |
| Cadmium | 3.27 | 37.74 | 1.7×10^4 | Class C grout in landfill | (Not assessed) | Perform quantitative risk assessment |
| Nitrate | 1.36 | 0.19 | 6.3×10^8 | Bin Sets-No Action | (Not assessed) | Perform quantitative risk assessment |
| Fluoride | 0.19 | 21.24 | 2.2×10^9 | PEW Evaporator | (Not assessed) | Perform quantitative risk assessment |
| Subtotal | 99.29 | 98.66 | | | | |
| All other compounds | 0.71 | 1.34 | | | | |
| Total | 100 | 100 | | | | |

a. In each case, the applicable closure alternative is Performance-based Closure or Closure to Landfill Standards.

b. Source: Rodriguez et al. (1997).

Table C.9-8. Identities of contaminants and distribution coefficients (cm^3/g) used for analysis of impacts from the disposition of facilities.

| | I | | II | | III | | IV | | V | |
|-------------|-----------------------------|------|------------------------------|------|--------------------------|------|-----------------------------------|------|---------------------------------------|------|
| | Non-reducing calcine, K_d | Ref. | Non-reducing concrete, K_d | Ref. | Reducing concrete, K_d | Ref. | Reducing contaminated zone, K_d | Ref. | Non-Reducing contaminated zone, K_d | Ref. |
| Sr-90 | 24 | c | 10 | a | 1 | d | 1 | d | 110 ^e | a |
| Tc-99 | 3 | c | 700 | a | 1,000 | d | 1,000 | d | 1 ^e | a |
| I-129 | 0 | c | 30 | a | 2 | d | 2 | d | 1 ^e | a |
| Cs-137 | 51 | c | 20 | a | 2 | d | 2 | d | 1,900 ^e | a |
| Np-237 | 3 | c | 5,000 | a | 5,000 | d | 5,000 | d | 55 ^e | a |
| Pu-238, 239 | NA | b | 5,000 | a | NA | b | NA | b | NA | b |
| Am-241 | 82 | c | 5,000 | a | 5,000 | d | 5,000 | d | 8,400 ^e | a |
| Cadmium | 15 | c | 567 | f | 567 | g | 567 | g | 567 | f |
| Fluoride | 0 | c | 0 | f | 0 | g | 0 | g | 0 | f |
| Mercury | 322 | c | 5,280 | f | 5,280 | g | 5,280 | g | 5,280 | f |
| Nitrate | 0 | c | 0 | f | 0 | g | 0 | g | 0 | f |

a. WSRP (1994), Table 3.3-2, page 3-69.

b. Solubility limit of 4.4×10^{-13} mols/liter used, WSRP (1994), page C-32.

c. MEPAS default for soil <10 percent clay and pH from 5-9.

d. Bradbury and Sarott (1995), Table 4, Region 1, page 42.

e. Value used for clay from WSRP (1994).

f. MEPAS default used for soil >30 percent clay and pH from 5-9.

g. MEPAS default used for soil >30 percent clay and pH >9.

Table C.9-10. Contaminant-specific parameter values used in closure modeling analyses.

| | Units | Radiological contaminants | | Notes |
|--|------------------------------------|---------------------------|------------------------|---|
| | | Tc-99 | I-129 | |
| Soil dermal absorption factor | unitless fraction | 0.1 | 0.1 | EPA default value for organics is used as a conservative estimate |
| Water contact permeability constant | cm/hr | 1.0×10^{-3} | 1.0×10^{-3} | No data for contaminants; value used is for water |
| Soil-root uptake factor | pCi/g plant per pCi/g soil | 40 | 0.4 | From Napier et al. (1988) or Yu (1993) (the higher of the two is used) |
| Soil-to-water distribution coefficient (K_d) | (g/cm ³) ⁻¹ | 3 | 0 | From Schafer (1999) |
| Food transfer coefficients | | | | |
| Intake-to-beef | pCi/kg per pCi/d | 9.9×10^{-4} | 0.007 | From Napier et al. (1988) or Yu (1993) (the higher of the two is used) |
| Intake-to-poultry | pCi/kg per pCi/d | 0.03 | 0.018 | From Napier et al. (1988) |
| Intake-to-milk | pCi/kg per pCi/d | 1.0×10^{-3} | 0.012 | From Napier et al. (1988) or Yu (1993) (the higher of the two is used) |
| Intake-to-eggs | pCi/kg per pCi/d | 3.0 | 2.8 | From Napier et al. (1988) |
| Radiation dose factors | | | | |
| Inhalation | (mrem/pCi) | 8.31×10^{-6} | 1.74×10^{-4} | From Federal Guidance Report No. 11 (EPA 1989) |
| Ingestion | (mrem/pCi) | 1.46×10^{-6} | 2.76×10^{-4} | From Federal Guidance Report No. 11 (EPA 1989) |
| Radionuclide carcinogenic slope factors | | | | |
| Inhalation | (risk/pCi) | 2.89×10^{-12} | 1.22×10^{-10} | From EPA HEAST database (EPA 1995) |
| Ingestion | (risk/pCi) | 1.40×10^{-12} | 1.84×10^{-10} | From EPA HEAST database (EPA 1995) |
| Nonradiological contaminants | | | | |
| | | Fluoride | Nitrate | Cadmium |
| Soil dermal absorption factor | unitless fraction | 0.1 | 0.1 | 0.1 From EPA Planning Remediation Guidance |
| Water contact permeability constant | cm/hr | 1.0×10^{-3} | 1.0×10^{-3} | 1.0×10^{-3} No data for contaminants; value used is for water |
| Soil-root uptake factor | mg/kg plant per mg/kg soil | 0.02 | 7.5 | 2.0 From Napier et al. (1988) or Yu (1993) (the higher of the two is used) |
| Soil-to-water distribution coefficient (K_d) | (g/cm ³) ⁻¹ | 0 | 0 | 6 From Schafer (1999) |
| Food transfer coefficients | | | | |
| Intake-to-beef | mg/kg per mg/d | 0.02 | 0.01 | 4.0×10^{-4} From Napier et al. (1988) or Yu (1993) (the higher of the two is used) |
| Intake-to-poultry | mg/kg per mg/d | 9.9×10^{-4} | 9.9×10^{-4} | 0.84 From Napier et al. (1988) |
| Intake-to-milk | mg/kg per mg/d | 7.0×10^{-3} | 0.011 | 1.0×10^{-3} From Napier et al. (1988) or Yu (1993) (the higher of the two is used) |
| Intake-to-eggs | mg/kg per mg/d | 9.9×10^{-4} | 9.9×10^{-4} | 1.0×10^{-3} From Napier et al. (1988) |
| Carcinogenic inhalation slope factor | (mg/kg-d) ⁻¹ | NA | NA | 6.3 From EPA IRIS database (EPA 1998) |
| Carcinogenic oral slope factor | (mg/kg-d) ⁻¹ | NA | NA | NA Data not available per EPA IRIS database (EPA 1998) |
| Noncarcinogenic inhalation reference dose | mg/kg-d | NA | NA | NA Data not available per EPA IRIS database (EPA 1998) |
| Noncarcinogenic oral reference dose | mg/kg-d | 0.06 | 1.6 | NA From EPA IRIS database (EPA 1998) |